

1      What is claimed is:

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3      1. In a blown film extrusion apparatus in which film is extruded as a tube from  
4      an annular die and then pulled along a predetermined path, an apparatus for startup  
5      of said extruded film tube, comprising:

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7            (a) means for varying a quantity of air within said extruded film tube,  
8                 including:

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10                  (1) a supply blower which supplies air to said extruded film tube in  
11                 an amount corresponding to a supply control signal, and

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13                  (2) an exhaust blower which exhausts air from said extruded film  
14                 tube in an amount corresponding to an exhaust control signal;  
15                 and

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17            (b) a controller member including executable program instructions which  
18                 define at least one control routine for automatic and coordinated  
19                 control of said means for varying during starting of said extruded film  
20                 tube by directing a series of supply control signals to said supply  
21                 blower and exhaust control signals to said exhaust blower.

1       2. An apparatus according to Claim 1, further comprising:

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3       (c) a control interface for receiving operator instructions during startup of  
4       said extruded film tube; and

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6       (d) wherein said controller further includes program instructions for  
7       receiving said operator instructions and integrating said operator  
8       instructions into said at least one control routine.

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12       3. An apparatus according to Claim 1, wherein said at least one control routine  
13       comprises at least one of the following routines:

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16       (a) a startup routine wherein said controller member initiates operation of  
17       said supply blower and said exhaust blower by first initiating operation  
18       of said supply blower in accordance with at least one predetermined  
19       operating parameter, and then initiating said exhaust blower in accor-  
20       dance with at least one predetermined operating parameter; and

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22       (b) a blower optimization routine wherein at least one of (1) said supply  
23       control signal, and (2) said exhaust control signal is determined at  
24       least in part from at least one prior recorded control signal.

1       4. An apparatus according to Claim 3, wherein said startup routine includes  
2 executable program instructions for:

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4       (1) initially increasing air supplied by said supply blower to said extruded  
5 film tube in accordance with a predetermined ramping function until  
6 said extruded film tube is substantially closed; and

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8       (2) then increasing air exhausted by said exhaust blower from said  
9 extruded film tube in accordance with a predetermined ramping  
10 function.

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14       5. An apparatus according to Claim 4, wherein said startup routine further  
15 includes executable program instructions for:

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17       (3) continued increasing operation of at least one of said supply blower  
18 and said exhaust blower in accordance with at least one predeter-  
19 mined function.

1       6. An apparatus according to Claim 1, further comprising:

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3       (c) a valve member, under control of said controller member, for varying  
4              admission of air into said extruded film tube and for controlling the  
5              circumference of said extruded film tube after startup of said extruded  
6              film tube.

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10      7. An apparatus according to Claim 6, wherein said at least one control routine  
11      comprises at least one of the following routines:

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13       (a) a startup routine wherein said controller member initiates operation of  
14              said supply blower and said exhaust blower by first initiating operation  
15              of said supply blower in accordance with at least one predetermined  
16              operating parameter, and then initiating said exhaust blower in accor-  
17              dance with at least one predetermined operating parameter; and

18  
19       (b) a blower optimization routine wherein at least one of (1) said supply  
20              control signal, and (2) said exhaust control signal is determined at  
21              least in part from at least one prior recorded control signal; and

22  
23       (c) a valve optimization routine wherein an operating condition is estab-  
24              lished for at least one of (1) said supply blower, and (2) said exhaust  
25              blower in a manner which optimizes operation of said valve member.

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1       8. An apparatus according to Claim 7, wherein, during said valve optimization  
2 routine, operating conditions are established for at least one of (1) said supply  
3 blower, and (2) said exhaust blower, in order to allow said valve member to operate  
4 in a preferred and substantially linear range of closure conditions.

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8       9. An apparatus according to Claim 1, further comprising:

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10      (c) at least one transducer for producing a signal corresponding to a  
11 detected position of said extruded film tube;

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13      (d) wherein said at least one control routine includes:

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15      (1) a bubble break detection routine wherein said signal generated  
16 by said at least one transducer is utilized in combination with at  
17 least one software timer in order to detect a break in said  
18 extruded film tube.

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- 1       10. An apparatus for extruding a film tube, comprising:
- 2
- 3       (a) a die member;
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- 5       (b) means for supplying molten film to said die member;
- 6
- 7       (c) a supply blower for supplying air to said extruded film tube in an
- 8       amount corresponding to a supply control signal;
- 9
- 10      (d) an exhaust blower for exhausting air from said extruded film tube in an
- 11      amount corresponding to an exhaust control signal;
- 12
- 13      (e) a valve for controlling air flow from said supply blower to said die
- 14      member in response to a valve control signal;
- 15
- 16      (f) a position sensor for providing a signal indicative of the size of said
- 17      extruded film tube;
- 18
- 19      (g) A controller member including executable instructions which define at
- 20      least one control routine;
- 21
- 22      (h) a control interface for receiving operator instructions; and
- 23
- 24      (i) said at least one control routine including:
- 25
- 26            a startup routine for automatic and coordinated control of
- 27            said supply blower and said exhaust blower during start-
- 28            up of said extruded film tube.
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1       11. An apparatus according to Claim 10, wherein said at least one control routine  
2 includes:

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- 4             (1) a startup routine wherein said controller member initiates operation of  
5             said supply blower and said exhaust blower by first initiating operation  
6             of said supply blower in accordance with at least one predetermined  
7             operating parameter, and then initiating operation of said exhaust  
8             blower in accordance with at least one predetermined operating  
9             parameter; and
- 10
- 11             (2) a blower optimization routine wherein at least one of (a) said supply  
12             control signal, and (b) said exhaust control signal is determined at  
13             least in part from at least one prior recorded control signal.

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18       12. An apparatus according to Claim 11, wherein said startup routine includes  
19       executable program instructions for:

- 20
- 21             (a) initially increasing air supplied by said supply blower to said extruded  
22             film tube in accordance with a predetermined ramping function until  
23             said extruded film tube is substantially closed; and
- 24
- 25             (b) then increasing air exhausted by said exhaust blower from said  
26             extruded film tube in accordance with a predetermined ramping  
27             function.
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1       13. An apparatus according to Claim 12, wherein said startup routine includes  
2 executable program instructions for:

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4           (c) continued increasing operation of at least one of said supply blower  
5 and said exhaust blower in accordance with at least one predetermined  
6 function.

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10      14. An apparatus according to Claim 11, wherein said at least one control routine  
11 further includes:

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13           (3) a valve optimization routine wherein an operating condition is established  
14 for at least one of (a) said supply blower, and (b) said exhaust  
15 blower in a manner which optimizes operation of said valve member.

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19      15. An apparatus according to Claim 14 wherein, during said valve optimization  
20 routine, operating conditions are established for at least one of (1) said supply  
21 blower, and (2) said exhaust blower, in order to allow said valve member to operate  
22 in a preferred and substantially linear range of closure conditions.

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26      16. An apparatus according to Claim 11, wherein said at least one control routine  
27 further includes:

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29           (3) a bubble break detection routine wherein said signal generated by said  
30 position sensor is utilized in combination with at least one software timer in order to  
31 detect a break in said extruded film tube.

- 1       17. A method of startup of an extruded film tube in a blown film extrusion  
2       apparatus, comprising:
- 3
- 4           (a) providing a controller, a supply blower, and an exhaust blower;
- 5
- 6           (b) utilizing said supply blower to supply air to said extruded film tube in  
7       an amount corresponding to a supply control signal;
- 8
- 9           (c) utilizing said exhaust blower to exhaust air from said extruded film tube  
10      in an amount corresponding to an exhaust control signal; and
- 11
- 12          (d) utilizing said controller member for executing program instructions  
13       which define at least one control routine for automatic and coordinated  
14       control during starting of said extruded film tube by directing a series  
15       of supply control signals to said supply blower and exhaust control  
16       signals to said exhaust blower.

1       18. A method according to Claim 17, further comprising:

2  
3       (e) providing a control interface for receiving operator instructions during  
4       startup of said extruded film tube; and

5  
6       (f) wherein said controller further executes program instructions for  
7       receiving said operator instructions and integrating said operator  
8       instructions into said at least one control routine.

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13       19. A method according to Claim 17, further comprising:

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15       (e) utilizing said controller to execute program instructions of a startup  
16       routine wherein said controller member initiates operation of said  
17       supply blower and said exhaust blower by first initiating operation of  
18       said supply blower in accordance with at least one predetermined  
19       operating parameter, and then initiating said exhaust blower in accor-  
20       dance with at least one predetermined operating parameter; and

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22       (f) utilizing said controller to execute program instructions of a blower  
23       optimization routine wherein at least one of (1) said supply control  
24       signal, and (2) said exhaust control signal is determined at least in part  
25       from at least one prior recorded control signal.

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1       20. A method according to Claim 19, wherein said startup routine includes  
2 executable program instructions for:

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4             (1) initially increasing air supplied by said supply blower to said extruded  
5                film tube in accordance with a predetermined ramping function until  
6                said extruded film tube is substantially closed; and

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8             (2) then increasing air exhausted by said exhaust blower from said  
9                extruded film tube in accordance with a predetermined ramping  
10              function.

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14        21. A method according to Claim 20, wherein said startup routine further includes  
15 executable program instructions for:

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17             (3) continued increasing operation of at least one of said supply blower  
18                and said exhaust blower in accordance with at least one predeter-  
19                mined function.

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1       22. A method according to Claim 17, further comprising:

2  
3       (e) providing a valve member, under control of said controller member, for  
4       varying admission of air into said extruded film tube and for controlling  
5       the circumference of said extruded film tube after startup of said  
6       extruded film tube.

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10      23. A method according to Claim 22, wherein said at least one control routine  
11      comprises at least one of the following routines:

- 12  
13       (1) a startup routine wherein said controller member initiates operation of  
14       said supply blower and said exhaust blower by first initiating operation  
15       of said supply blower in accordance with at least one predetermined  
16       operating parameter, and then initiating said exhaust blower in accor-  
17       dance with at least one predetermined operating parameter; and  
18  
19       (2) a blower optimization routine wherein at least one of (1) said supply  
20       control signal, and (2) said exhaust control signal is determined at  
21       least in part from at least one prior recorded control signal; and  
22  
23       (3) a valve optimization routine wherein an operating condition is estab-  
24       lished for at least one of (1) said supply blower, and (2) said exhaust  
25       blower in a manner which optimizes operation of said valve member.

1       24. A method according to Claim 23, wherein, during said valve optimization  
2       routine, operating conditions are established for at least one of (1) said supply  
3       blower, and (2) said exhaust blower, in order to allow said valve member to operate  
4       in a preferred and substantially linear range of closure conditions.

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9       25. A method according to Claim 17, further comprising:

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11       (e) providing at least one transducer for producing a signal corresponding  
12       to a detected position of said extruded film tube;

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14       (f) wherein said at least one control routine includes a bubble break  
15       detection routine wherein said signal generated by said at least one  
16       transducer is utilized in combination with at least one software timer in  
17       order to detect a break in said extruded film tube.

- 1       26. An improved blown film extrusion apparatus, comprising:
- 2
- 3       (a) a die for receiving molten material and extruding a film tube;
- 4
- 5       (b) a controller member;
- 6
- 7       (c) a supply blower which is responsive to command signals from said
- 8       controller for supplying a variable quantity of air to said film tube;
- 9
- 10      (d) an airflow path between said supply blower and said die;
- 11
- 12      (e) an exhaust blower which is responsive to command signals from said
- 13       controller for exhausting a variable quantity of air from said film tube;
- 14
- 15      (f) an air flow control member which is at least in-part responsive to
- 16       command signals from said controller member for varying a quantity
- 17       of air passing within said air flow path, and which includes:
- 18
- 19       (1) a housing with an inlet, an outlet, and an air path defined there-
- 20       through;
- 21
- 22       (2) at least one selectively-expandable flow restriction member dis-
- 23       posed in said housing in said air flow path; and
- 24
- 25       (3) wherein said air flow member selectively expands and reduces
- 26       said at least one selectively-expandable flow restriction member
- 27       to moderate air flow through said air flow path.
- 28
- 29      (g) at least one program routine executable by said controller member
- 30       which optimizes operation of said supply blower, said exhaust blower,
- 31       and said air flow control member.

1       27. An improved blown film apparatus according to Claim 26:

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3           (h) wherein said at least one selectively-expandable flow restriction

4           member includes a bladder member which selectively communicates

5           with a control fluid; and

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7           (i) wherein application of said control fluid to said at least one selectively-

8           expandable flow restriction member causes expansion and reduction

9           of said at least one selectively-expandable flow restriction member.

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14       28. An improved blown film apparatus according to Claim 26, wherein said air

15       flow control member includes:

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17           (1) a plurality of housings, each having an inlet, outlet, and an air flow

18           path defined therethrough;

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20           (2) a plurality of selectively-expandable flow restriction members disposed

21           in each of said housings; and

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23           (3) with each flow path through said plurality of housings in at least one

24           of (a) series, and (b) parallel communication with said selected others

25           of said air flow paths.

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1       29. An improved blown film apparatus, according to Claim 26, wherein:

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3             (h) expansion of said at least one selectively-expandable flow restriction  
4                   member restricts said air path defined through said housing; and

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6             (i) reduction of said at least one selectively-expandable flow restriction  
7                   member expands said air path defined through said housing.

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